



U.S. Environmental Protection Agency

Ground Water & Drinking Water

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Technical Factsheet on: LEAD

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As part of the Drinking Water and Health pages, this fact sheet is part of a larger publication:

National Primary Drinking Water Regulations

Drinking Water Standards

MCLG: zero

Action Level: > 0.015 mg/L in more than 10 percent of tap water samples

HAL(child): none

Health Effects Summary

Acute: Lead can cause a variety of adverse health effects in humans. At relatively low levels of exposure, these effects may include interference with red blood cell chemistry, delays in normal physical and mental development in babies and young children, slight deficits in the attention span, hearing, and learning abilities of children, and slight increases in the blood pressure of some adults. It appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold.

Chronic: Chronic exposure to lead has been linked to cerebrovascular and kidney disease in humans.

Cancer: Lead has the potential to cause cancer from a lifetime exposure at levels above the action level.

Usage Patterns

Lead is the fifth most important metal in the USA economy in terms of consumption. Of this approximately 85% of the primary lead is produced domestically and 40-50% is recovered and recycled. Eighty eight percent of the lead mined in the US comes from seven mines in the New Lead Belt in southeastern Missouri; the rest coming from eight mines in Colorado, Idaho, and Utah. Three of the six USA lead smelters are from this region, the others are located in Idaho, Montana, and Texas.

Release Patterns

Lead occurs in drinking water from two sources: (1) Lead in raw water supplies, i.e., source water or distributed water, and (2) corrosion of plumbing materials in the water distribution system (corrosion by-products). Most lead contamination is from corrosion by-products.

Occurrence in Source Water and Distributed Water. Based on a variety of water quality surveys, EPA now estimates that approximately 600 groundwater systems and about 215 surface suppliers may have water leaving the treatment plant with lead levels greater than 0.005 mg/L. These two sources together indicate that less than 1 percent of the public water systems in the United States have water entering the distribution system with lead levels greater than 0.005 mg/L. These systems serve less than 3 percent of people that

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receive their drinking water from public water systems.

From 1987 to 1993, according to the Toxics Release Inventory lead compound releases to land and water totalled nearly 144 million lbs., almost all of which was to land. These releases were primarily from lead and copper smelting industries. The largest releases occurred in Missouri, Arizona and Montana. The largest direct releases to water occurred in Ohio.

Occurrence as a Corrosion By-Product. Lead in drinking water results primarily from corrosion of materials located throughout the distribution system containing lead and copper and from lead and copper plumbing materials used to plumb public- and privately-owned structures connected to the distribution system. The amount of lead in drinking water attributable to corrosion by-products depends on a number of factors, including the amount and age of lead and copper bearing materials susceptible to corrosion, how long the water is in contact with the lead containing surfaces, and how corrosive the water in the system is toward these materials.

The potential sources of lead corrosion by-products found in drinking water can include: Water service mains (rarely), lead goosenecks or pigtails, lead service lines and interior household pipes, lead solders and fluxes used to connect copper pipes, alloys containing lead, including some faucets made of brass or bronze.

Most public water systems serve at least some buildings with lead solder and/or lead service lines. EPA estimates that there are about 10 million lead service lines/connections. About 20 percent of all public water systems have some lead service lines/connections within their distribution system.

The amount of lead in drinking water depends heavily on the corrosivity of the water. All water is corrosive to metal plumbing materials to some degree, even water termed noncorrosive or water treated to make it less corrosive. The corrosivity of water to lead is influenced by water quality parameters such as pH, total alkalinity, dissolved inorganic carbonate, calcium, and hardness. Galvanic corrosion of lead into water also occurs with lead-soldered copper pipes, due to differences in the electrochemical potential of the two metals. Grounding of household electrical systems to plumbing may also exacerbate galvanic corrosion.

Environmental Fate

Lead may enter the environment during its mining, ore processing, smelting, refining use, recycling or disposal. The initial means of entry is via the atmosphere. Lead may also enter the atmosphere from the weathering of soil and volcanos, but these sources are minor compared with anthropogenic ones.

Lead will be retained in the upper 2-5 cm of soil, especially soils with at least 5% organic matter or a pH 5 or above. Leaching is not important under normal conditions. It is expected to slowly undergo speciation to the more insoluble sulfate, sulfide, oxide, and phosphate salts.

Lead enters water from atmospheric fallout, runoff or wastewater; little is transferred from natural ores. Metallic lead is attacked by pure water in the presence of oxygen, but if the water contains carbonates and silicates, protective films are formed preventing further attack. That which dissolves tends to form ligands. Lead is effectively removed from the water column to the sediment by adsorption to organic matter and clay minerals, precipitation as insoluble salt, and reaction with hydrous iron and manganese oxide. Under most circumstances, adsorption predominates.

Lake sediment microorganisms are able to directly methylate certain inorganic lead compounds. Under appropriate conditions, dissolution due to anaerobic microbial action may be significant in subsurface environments. The mean percentage removal of lead during the activated sludge process was 82% and was almost entirely due to the removal of the insoluble fraction by adsorption onto the sludge floc and to a much lesser extent,

precipitation.

The most stable form of lead in natural water is a function of the ions present, the pH, and the redox potential. In oxidizing systems, the least soluble common forms are probably the carbonate, hydroxide, and hydroxycarbonate. In reduced systems where sulfur is present, PbS is the stable solid. The solubility of Pb is 10 ppb above pH 8, while near pH 6.5 the solubility can approach or exceed 100 ppb. Pb(0) and Pb(+2) can be oxidatively methylated by naturally occurring compounds such as methyl iodide and glycine betaine. This can result in the dissolution of lead already bound to sediment or particulate matter.

Lead does not appear to bioconcentrate significantly in fish but does in some shellfish such as mussels. Evidence suggests that lead uptake in fish is localized in the mucous on the epidermis, the dermis, and scales so that the availability in edible portions do not pose a human health danger.

Chemical/Physical Properties

CAS Number: 7439-92-1

Color/ Form/Odor: Bluish-white, silvery, gray metal, lustrous when freshly cut.

Soil sorption coefficient: N/A; Low mobility in most soils, lowest at neutral pH and high organic matter.

Common Ores: sulfide-Galena; oxide-Lanarkite; carbonate-Cerussite; sulfate-Anglesite

Bioconcentration Factor: Log BCFs for fish, 1.65; shellfish, 3.4

Solubilities:

acetate- 443 g/L at 20 deg C
 arsenate- insoluble in cold water
 carbonate- 0.0011 g/L at 20 deg C
 chloride- 10 g/L cold water
 chromate- 0.2 mg/L
 nitrate- 376.5 g/L at 0 deg C
 oxide- 0.05 g/L at 20 deg C
 dioxide- insoluble
 phosphate- insoluble
 sulfate- 0.4 g/L
 sulfide- insoluble
 tetraethyl- 0.29 mg/L at 25 deg C
 thiocyanate- 0.5 g/L at 20 deg C
 thiosulfate- 0.3 g/L cold water

Other Regulatory Information

Monitoring:	For Lead	For Water Quality Parameters	
&\$160;	At Home Taps	Within the Distribution System	At Entry to the Distribution System
Monitoring Period			
Initial	Every 6 months	Every 6 months	Every 6 months
After corrosion control installation	Every 6 months	Every 6 months	Every 2 weeks
Reduced monitoring			
- Conditional	Once a year	Every 6 months	Every 2 weeks
- Final	Every 3 years	Every 3 years	Every 2 weeks

Analysis

Reference Source
 EPA 800/4-83-043

Method Number
 239.2; 200.8; 200.9

Treatment/Best Available Technologies

Source water: Ion exchange; lime softening; reverse osmosis; coagulation/filtration

Corrosion Control: pH and alkalinity adjustment; calcium adjustment; silica- or phosphate-based corrosion inhibition

Toxics Release Inventory - Water and Land Releases, 1987-93 (in pounds)

TOTALS		Water 970,827	Land 143,058,771
Top Twelve States *			
MO	4,408		40,656,278
AZ	771		23,240,625
MT	0		20,822,517
UT	4,600		11,881,000
TX	1,988		11,515,211
OH	127,990		5,196,522
IN	62,894		4,851,940
TN	7,140		2,095,489
IL	26,601		1,930,000
WI	1,310		1,350,960
MN	0		1,313,895
NM	0		1,060,880
Major Industries*			
Lead smelting, refining		31,423	68,996,819
Copper smelting		5,371	34,942,505
Steelworks, blast furn.		379,849	18,149,696
Storage batteries		0	1,867,292
China plumbing fixtures		1,310	1,350,960
Iron foundries		10,021	1,274,777
Copper mining		0	1,240,000

* State/Industry totals only include facilities with releases greater than 100,000 lbs.

For Additional Information:

EPA can provide further regulatory and other general information:
EPA Safe Drinking Water Hotline - 800/426-4791

Other sources of toxicological and environmental fate data include:
Toxic Substance Control Act Information Line - 202/554-1404
Toxics Release Inventory, National Library of Medicine - 301/496-6531
Agency for Toxic Substances and Disease Registry - 404/639-6000

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